RESEARCH DEPARTMENT

POWER MEASUREMENT IN THE FREQUENCY RANGE 30-1000 Mc/s

Report No. E-054/2

(1961/8)

THE BRITISH BROADCASTING CORPORATION
ENGINEERING DIVISION

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Section	Title	Page
1	INTRODUCTION	1
2	THE BRIDGE UNIT	1
	2.1. The Power Supplies	1
	2.2. The Bridge	1
3	MEASURING PROCEDURE	3
4	REFERENCE	3

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1. INTRODUCTION

The power measuring equipment described in Research Department Report No. E-054[1] is useful for the direct measurement of r.f. power over the range 20 mW-1 mW. A small modification permits this range to be extended to powers between 1 mW and 50 μW.

The separate d.c. supply unit to the bridge, being an adaptation, was cumbersome in use and has been replaced by a compact unit built on the same chassis as the d.c. bridge unit.

The thermistor head is unchanged.

2. THE BRIDGE UNIT

The bridge unit consists of two parts (1) the power supply unit and (2) the modified bridge unit. The complete circuit diagram is shown in Fig. 1.

2.1. The Power Supplies

The power supply consists of a small C-core transformer followed by a full-wave germanium rectifier (MR1 and MR2) and a two stage Zener diode stabiliser (MR3 and MR4).

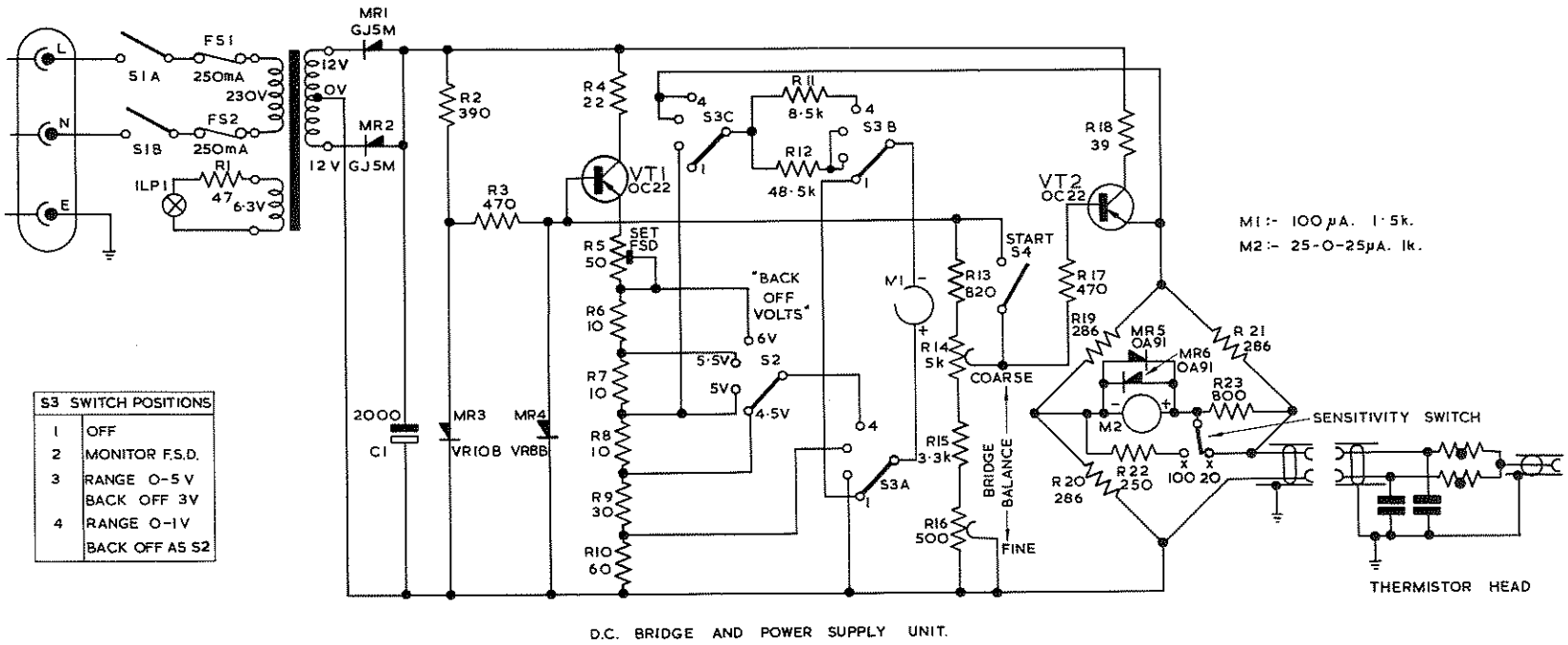
The use of such a stabiliser necessitates only one tap on the transformer primary for all supply voltages between 200 V and 250 V. An emitter follower VT1 provides a low impedance source for the voltmeter backing-off potential chain and a preset resistor R5 allows the voltmeter to be accurately calibrated. A second emitter follower VT2 provides a low impedance variable supply for the bridge.

A push-button switch S4 applies 8 V to the bridge and enables the thermistors quickly to arrive at their working temperature.

2.2. The Bridge

The thermistor head and bridge are unaltered from those previously described[1] but the variable sensitivity shunt across the bridge balance meter has been replaced by a two-position sensitivity switch. This allows the bridge to be calibrated for unbalanced working.

Protection diodes are provided across the meter to reduce the effects of overloads.



D.C. BRIDGE AND POWER SUPPLY UNIT.

Fig. 1

3. MEASURING PROCEDURE

For the measurement of powers greater than 2 mW the original method of balancing the bridge, with and without the r.f. input to the thermistor head, is used. The r.f. power is calculated as shown in Research Department Report No. E-054[1] and is given by $0{\cdot}874\ (V_s - V_m)(V_s + V_m)$ mW* where 0·874 is the bridge constant and V_s and V_m are respectively the voltages required to balance the bridge before and after the addition of the r.f. power.

For powers less than 2 mW the bridge is balanced with the r.f. power into the thermistor head and the reading V of the bridge voltmeter noted. The r.f. power is then removed and the reading of the bridge balance meter noted. This sequence of operation ensures that the thermistor head provides a matched load for the r.f. power. For the small changes of resistance involved in the thermistors the meter current will be proportional to the r.f. power and, as the bridge is fed from a low impedance source, the voltage across the bridge remains constant. Hence to a first order it can be shown that

$$\text{Power} = \mu A \cdot S \cdot \frac{K}{V} \mu W$$

where μA = meter unbalance current in μA

S = meter range (either × 20 or × 100)

V = bridge voltage measured at balance

K = thermistor head constant.

The constant K will depend upon the rate of change of resistance of the thermistors with dissipation and may be found either by direct measurement or by calibration using known r.f. powers and attenuators.

Since the temperature change of the thermistors is approximately 0·25 deg.C per 50 μW input power, care must be taken to keep the thermistor head out of draughts and to take the two meter readings in rapid succession.

4. REFERENCE

1. "Power Measurement in the Frequency Range 30–1000 Mc/s", Research Department Report No. E-054, Serial No. 1956/22.

*Subsequent to the issue of Research Department Report No. E-054 the bridge constant has been changed from 0·880 to 0·874 corresponding with the bridge resistors which are now 286 ohms.

MM

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